

CIMCOOL[®]

Technical Report

Milacron Marketing Co. LLC | CIMCOOL[®] Fluid Technology | Cincinnati, Ohio 45209

MACHINING MAGNESIUM using Water-Based METALWORKING FLUIDS

The metalworking or processing of Magnesium and alloys of Magnesium requires specific knowledge of the material properties and proper safety precautions. Magnesium (Mg) and its alloys have unique properties that require proper handling, before, during, and after metalworking operations. In this report, the use of the word "Magnesium" refers to elemental Magnesium and any of the wrought or die cast alloys.

Material Properties

Pure Mg Parameters	Properties & Values
Reactivity	Highly reactive
Pyrophoricity	Combustible metal
Autoignition Point ¹	473° C (alloys 427°C) ²
Melting Point ¹	650° C
Density	1.738 g/cm ³
Magnetic Character	Non-magnetic

¹International Chemical Safety Card, National Institute for Occupational Safety and Health (NIOSH)

²Office of Nuclear Safety, HS-30, Primer on Spontaneous Heating and Pyrophoricity, Department of Energy

Magnesium is a pyrophoric metal, that can burn. It is important to be aware that its properties can be different when the size and shape of the material changes. Thin chips or shavings from machining operations can ignite more readily than ingots. Powder or dust from grinding or other operations can present an explosion hazard.

Material Safety Precautions

Since Magnesium can burn, special fire fighting equipment must be available. Class D fire extinguishers are required for combustible metals. For safe machining, avoid excess heat generation in the process and promptly remove all chips from the machine. Magnesium chips,

swarf, and turnings should never be mixed with other materials. In the presence of water, explosive Hydrogen gas can be generated. Become familiar with the following safety standards before beginning operations with Magnesium.

Standard	Title
NFPA* 10	Standard for Portable Fire Extinguishers
NFPA 480	Storage, Handling & Processing of Magnesium Solids & Powders

*NFPA – National Fire Protection Association

Process Safety Precautions

The machining of Magnesium requires a high level of process control. A machine or process dedicated to this material requires the installation of specialty safety equipment. An enclosed machine should be equipped with Hydrogen gas monitoring, explosion-proof electrical equipment and effective venting along with fire suppression equipment. Equipment must have proper electrical grounding. Operators should wear protective clothing, and respirators need to be used if the process creates fuming. A dedicated machine also provides practical and economic advantages. Segregation of Magnesium chips permits more efficient recycling and helps to prevent bimetallic (galvanic) corrosion. Review the following standards, which provide additional information for worker safety before beginning to work with Magnesium.

Standard	Title
ANSI** Z49.1	Safety in Welding, Cutting and Allied Processes
OSHA***IMIS Code M100	Integrated Management Information System – Chemical Sampling, Magnesium

**ANSI – American National Standards Institute

***OSHA - Occupational Safety & Health Administration

CIMCOOL® Technical Report

Milacron Marketing Co. LLC | CIMCOOL® Fluid Technology | Cincinnati, Ohio 45209

Process Design Requirements

The most important aspect of process design for machining Magnesium involves minimizing heat buildup from the operation being performed. Heat buildup in the operation is reduced by efficient cutting with sharp, spark-proof tools and immediate removal of chips from the machine by an automatic chip conveyor. It is also important to minimize the time-of-contact between any metalworking fluid that is used and the chips, swarf, or other fine particles from the process. This requires an automatic chip drag-out system to remove chips from the fluid sump. This will facilitate rapid drying of chips. In addition, it is necessary to facilitate the drying of processed parts. In order to avoid galvanic corrosion, jigs, fixtures and fasteners should be designed of materials that are compatible with Magnesium.

Fluid System Requirements

The remaining portion of this technical report will focus on the use of water-based metalworking fluids for Magnesium machining operations. A primary advantage of using water-based metalworking fluid in the metalworking process is that it allows the most efficient heat extraction and control of cutting zone temperature possible. Flooding the part with fluid continues to provide the expected benefits of chip evacuation from the cutting zone, controlling dust generation, prolonging tool life, and improving surface finish.

When using water-based metalworking fluids in Magnesium operations, it is recommended that deionized water be used for mixing product. This will help to reduce the buildup of minerals over time and prolong the useful life of the mix. The maintenance of proper mix concentration is especially important with Magnesium machining. The following reference has additional best practices for machining operations.

Standard	Title
EPA****D2.2	Metal Products & Machinery Effluent Limitation Guidelines "Pollution Prevention & Water Conservation Practices for Machining Operations"

****EPA – Environmental Protection Agency

Metalworking Fluid Recommendations

The selection of the proper metalworking fluid for any operation must be based upon a review of all aspects of the process. Magnesium machining operations are no exception. The fluid selected must provide the proper corrosion protection, minimize hydrogen release, provide excellent microbial control, exhibit low foaming and have good lubrication properties. All of these performance criteria are critical to achieving optimal machining operations. There are CIMCOOL® metalworking fluids available that are suitable for machining Magnesium. For specific information on these products refer to the Product Information Folder and Safety Data Sheet.

Consult your regional CIMCOOL® Technical Service Engineer for specific recommendations, or call CIMCOOL® Technical Service at 1-513-458-8199.

Limitation of Liability:

Under no circumstances, shall we or any affiliate of ours have any liability whatsoever for loss of use, or for any indirect or consequential damages from the use of these products.